Problem 4.26: A Radical Radio Idea

An ELEC 241 student has the bright idea of using a square wave instead of a sinusoid as an AM carrier. The transmitted signal would have the form

$$x(t) = A(1 + m(t))sqT(t)$$

where the message signal ***m (t)*** would be amplitude-limited: |***m (t)*** | < ***1***

1. Assuming the message signal is lowpass and has a bandwidth of ***W*** Hz, what values for the square wave's period ***T*** are feasible. In other words, do some combinations of ***W*** and ***T*** prevent reception?
2. Assuming reception is possible, can standard radios receive this innovative AM transmission? If so, show how a coherent receiver could demodulate it; if not, show how the coherent receiver's output would be corrupted. Assume that the message bandwidth ***W*** =5 kHz.

Problem 4.27: Secret Communication

An amplitude-modulated secret message m (t) has the following form.

$$r(t) = A(1 + m(t))cos(2\pi(f_c + f_0)t)$$

The message signal has a bandwidth of ***W*** Hz and a magnitude less than 1 (|m (t) | < 1). The idea is to offset the carrier frequency by f_0 Hz from standard radio carrier frequencies. Thus, "of-the-shelf" coherent demodulators would assume the carrier frequency has fc Hz. Here, $f_0 < W$.

1. Sketch the spectrum of the demodulated signal produced by a coherent demodulator tuned to f_c Hz.
2. Will this demodulated signal be a "scrambled" version of the original? If so, how so; if not, why not?
3. Can you develop a receiver that can demodulate the message without knowing the offset frequency f_c?